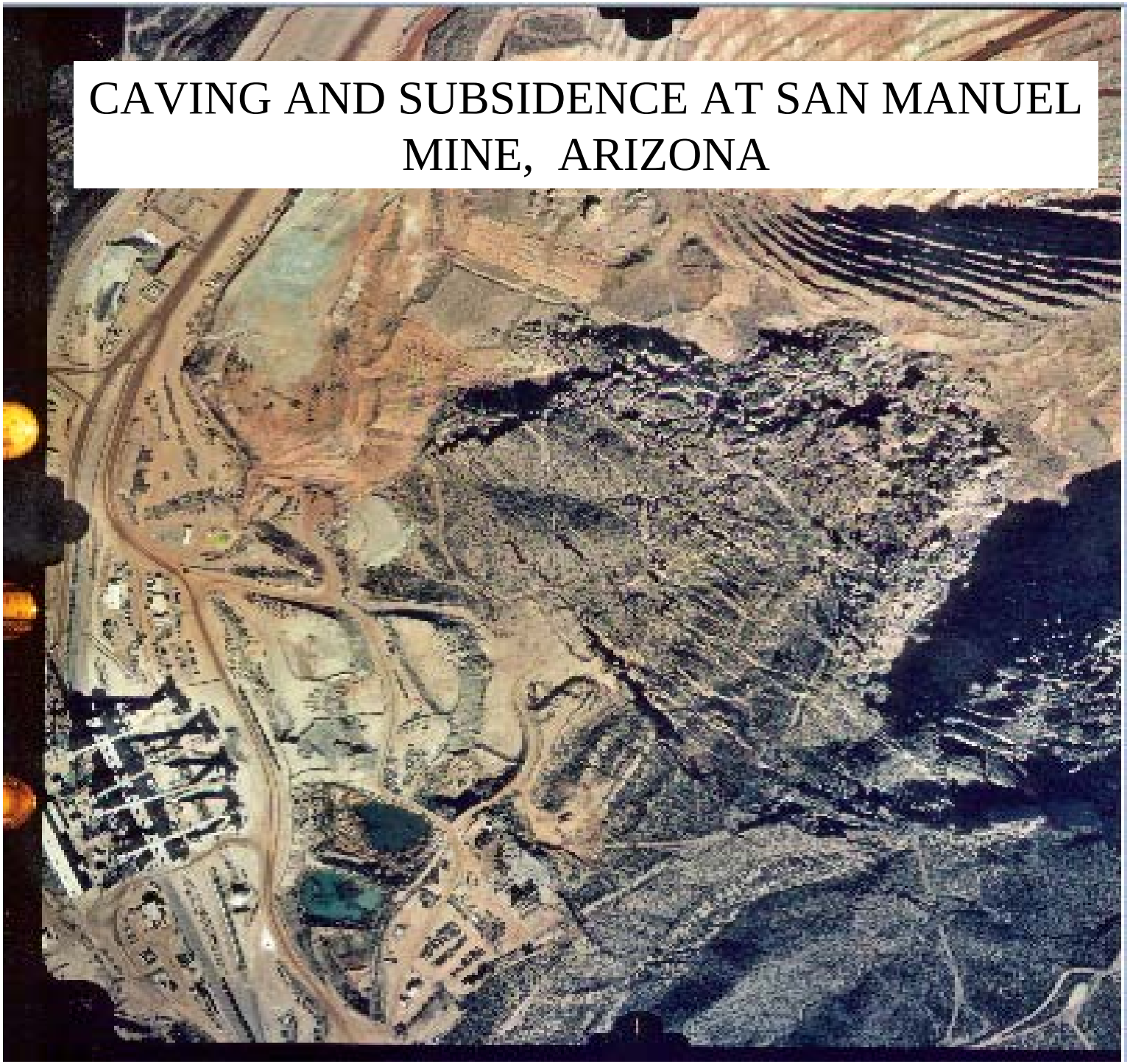
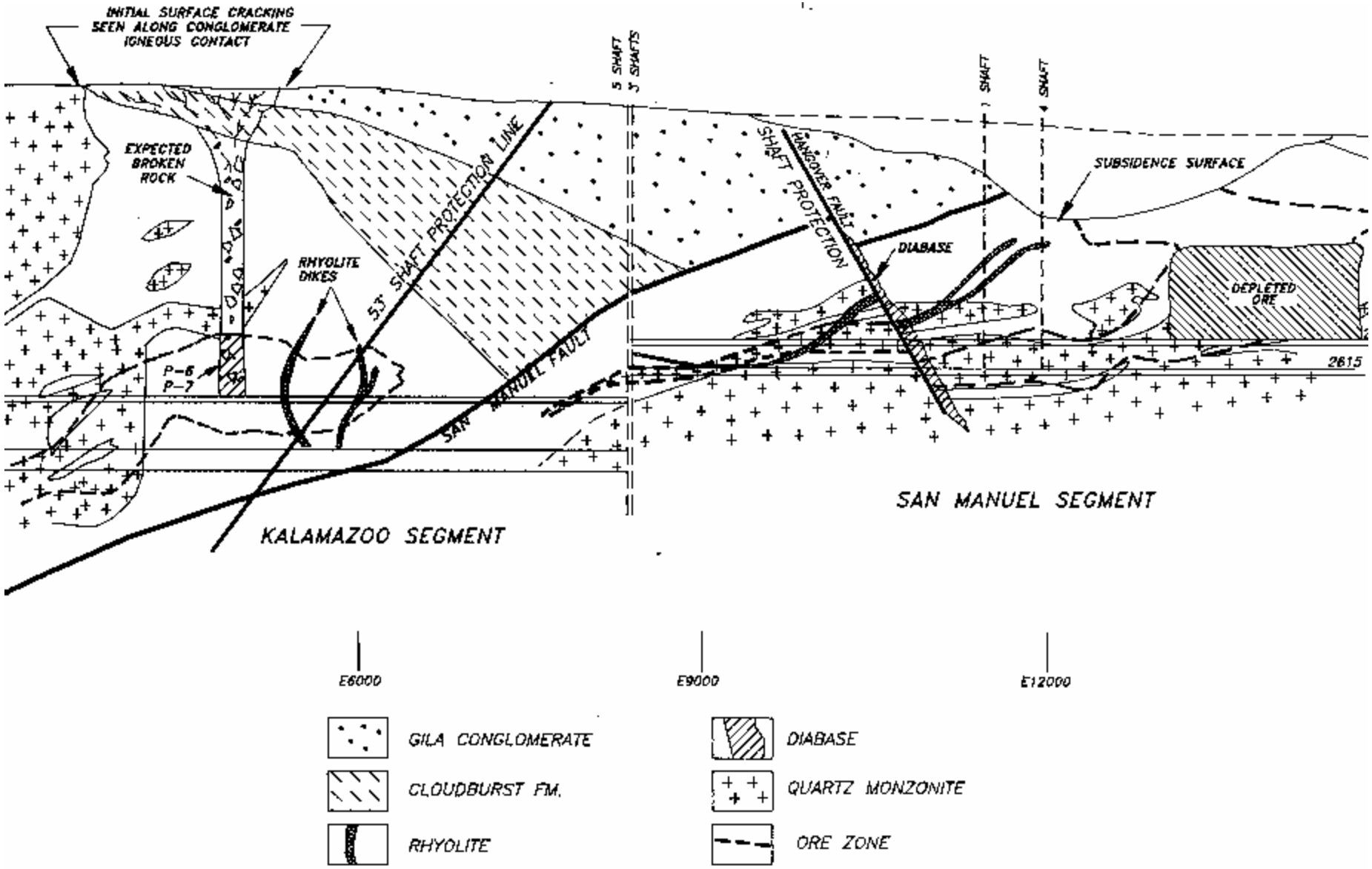
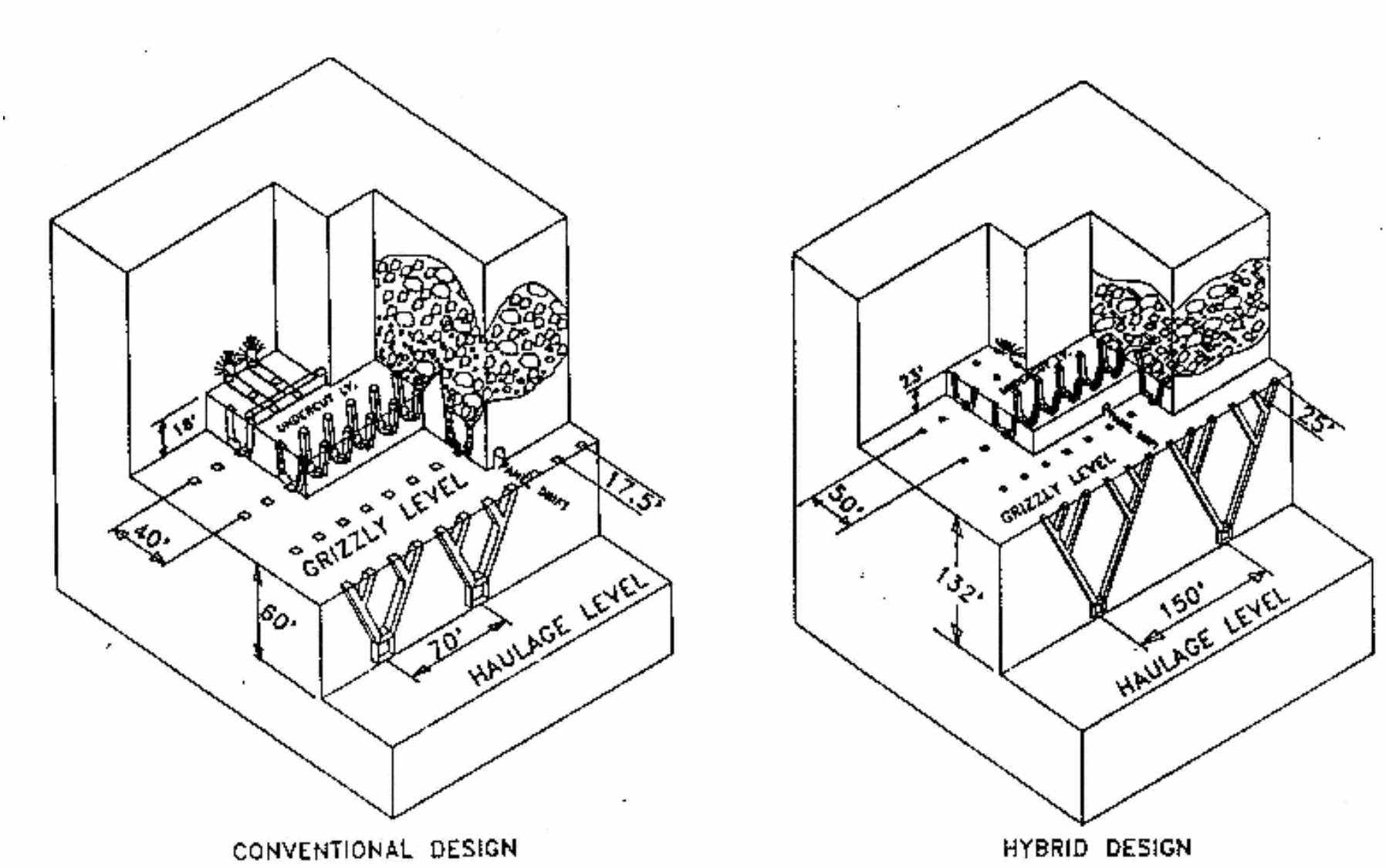
CAVING AND SUBSIDENCE AT SAN MANUEL MINE, ARIZONA

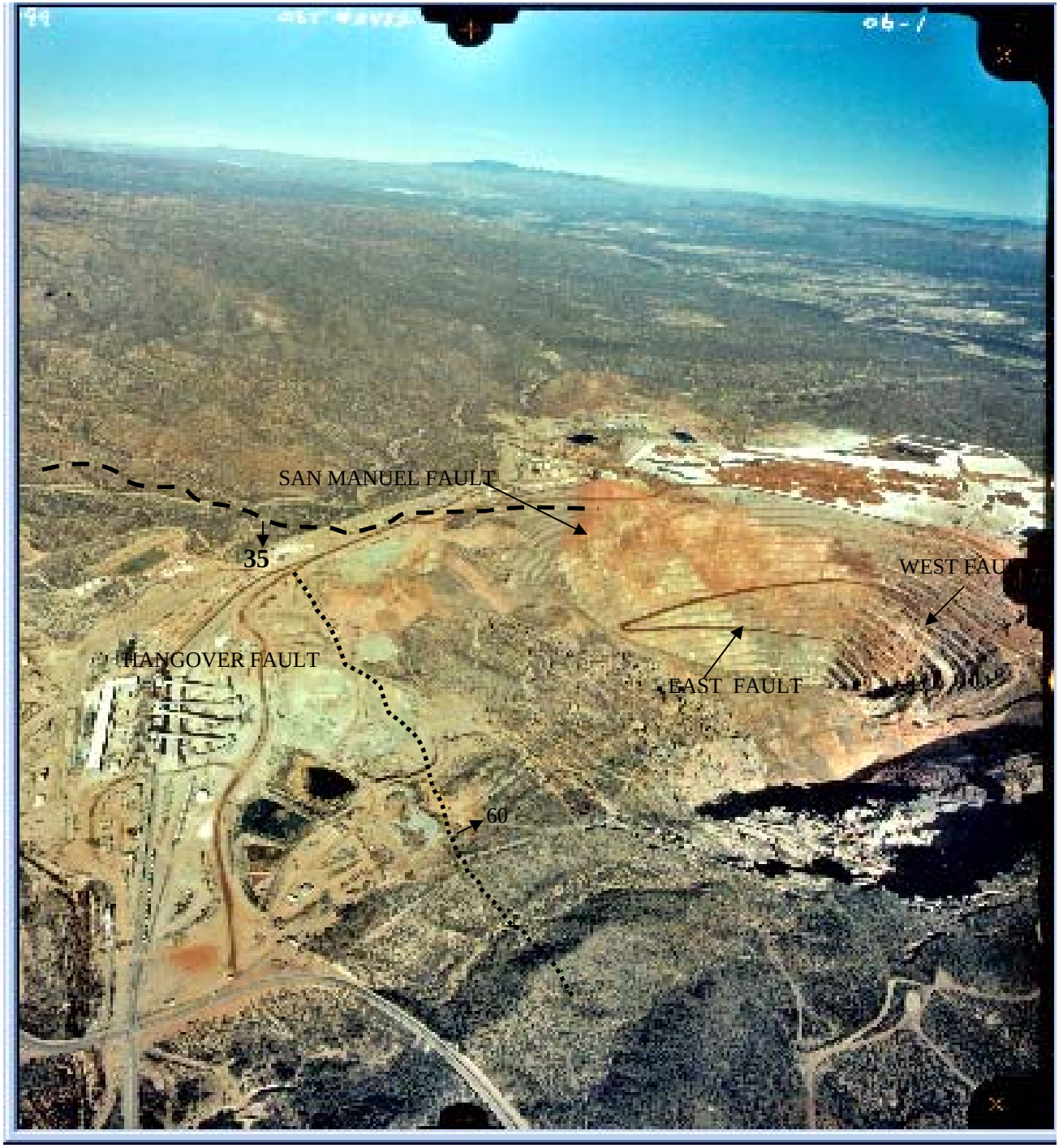


LONG SECTION SAN MANUEL-KALAMAZOO

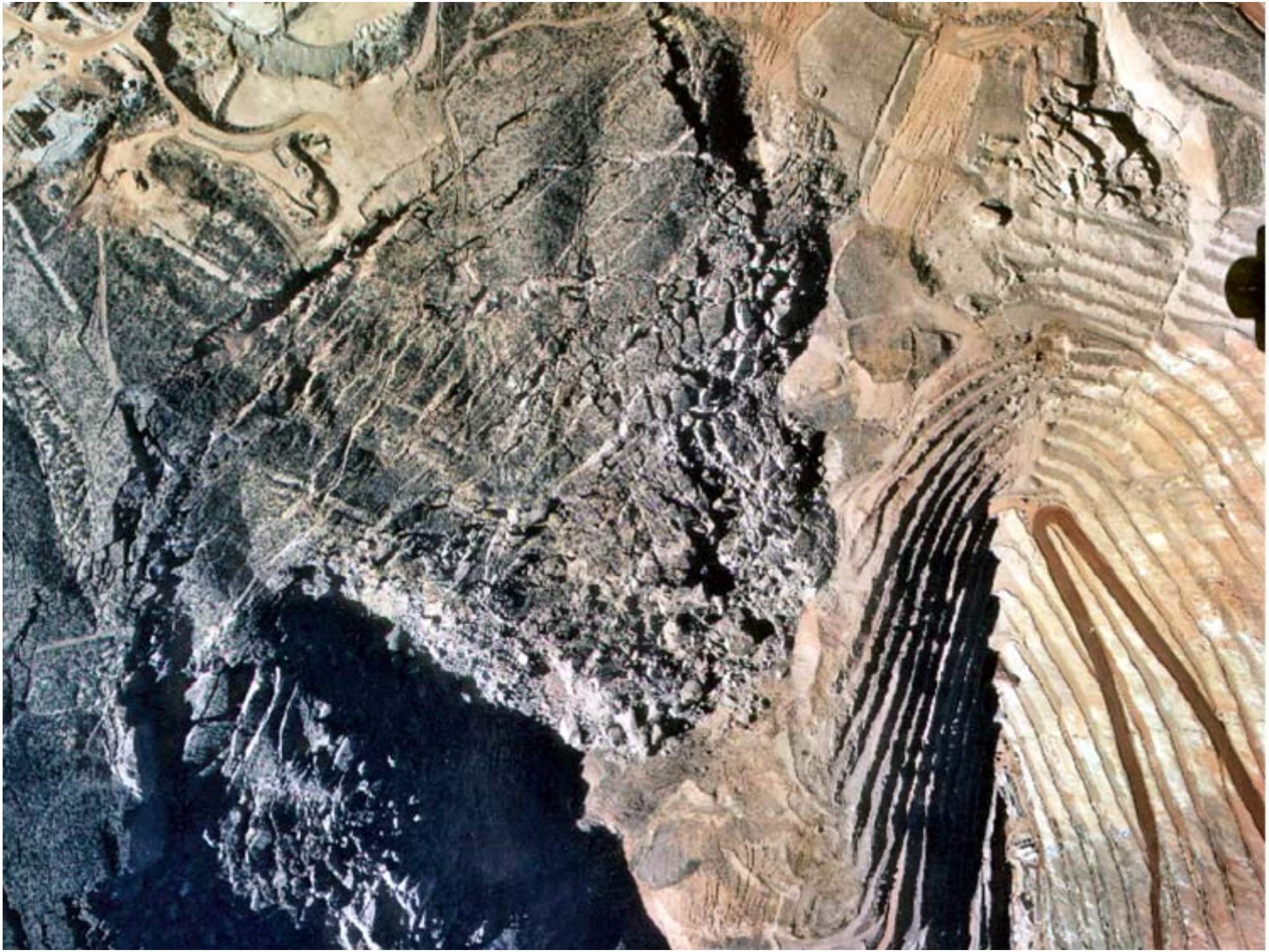


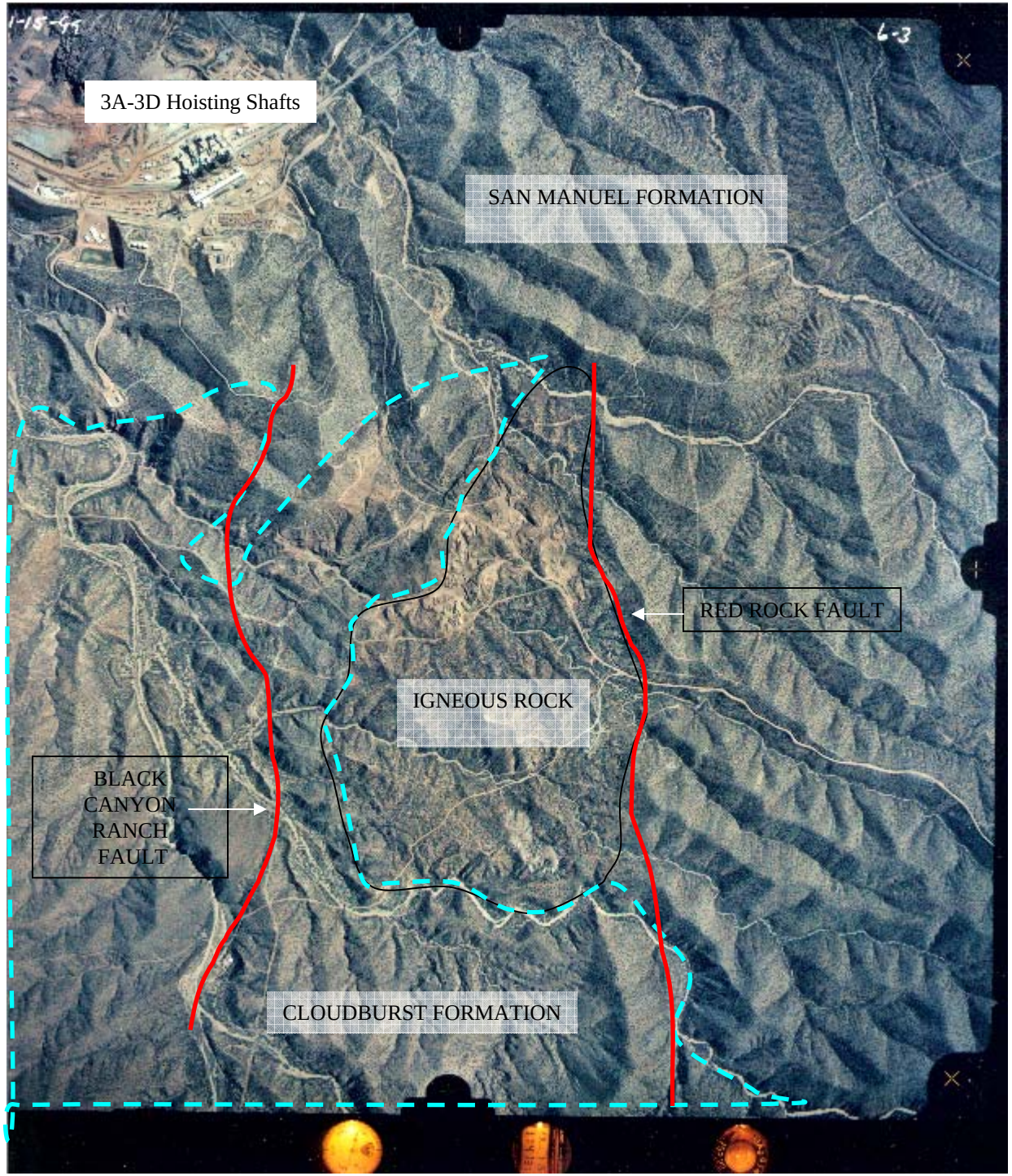
Block Caving Design

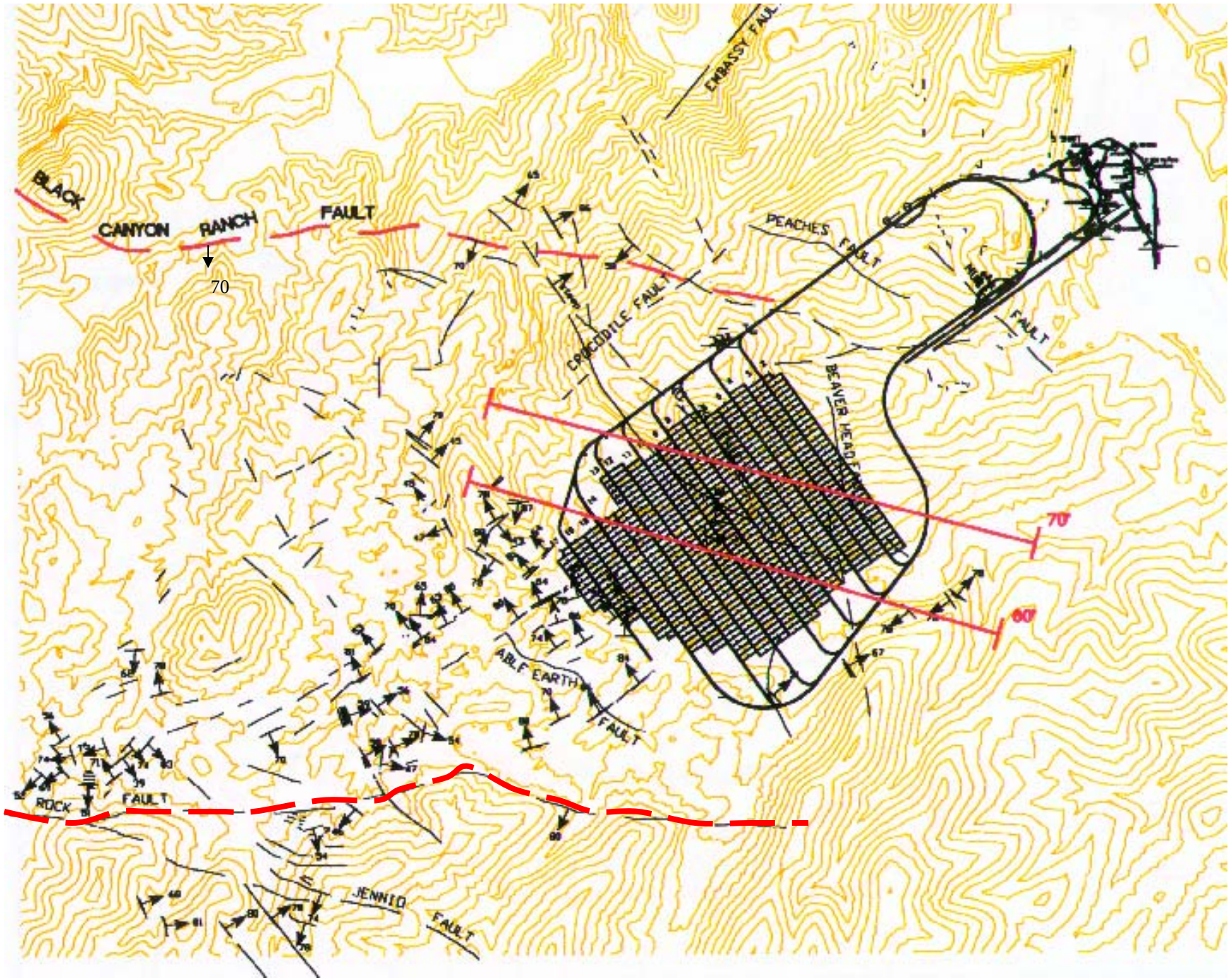



SAN MANUEL FAULT
35
WEST FAU
HANGOVER FAULT
EAST FAULT
60

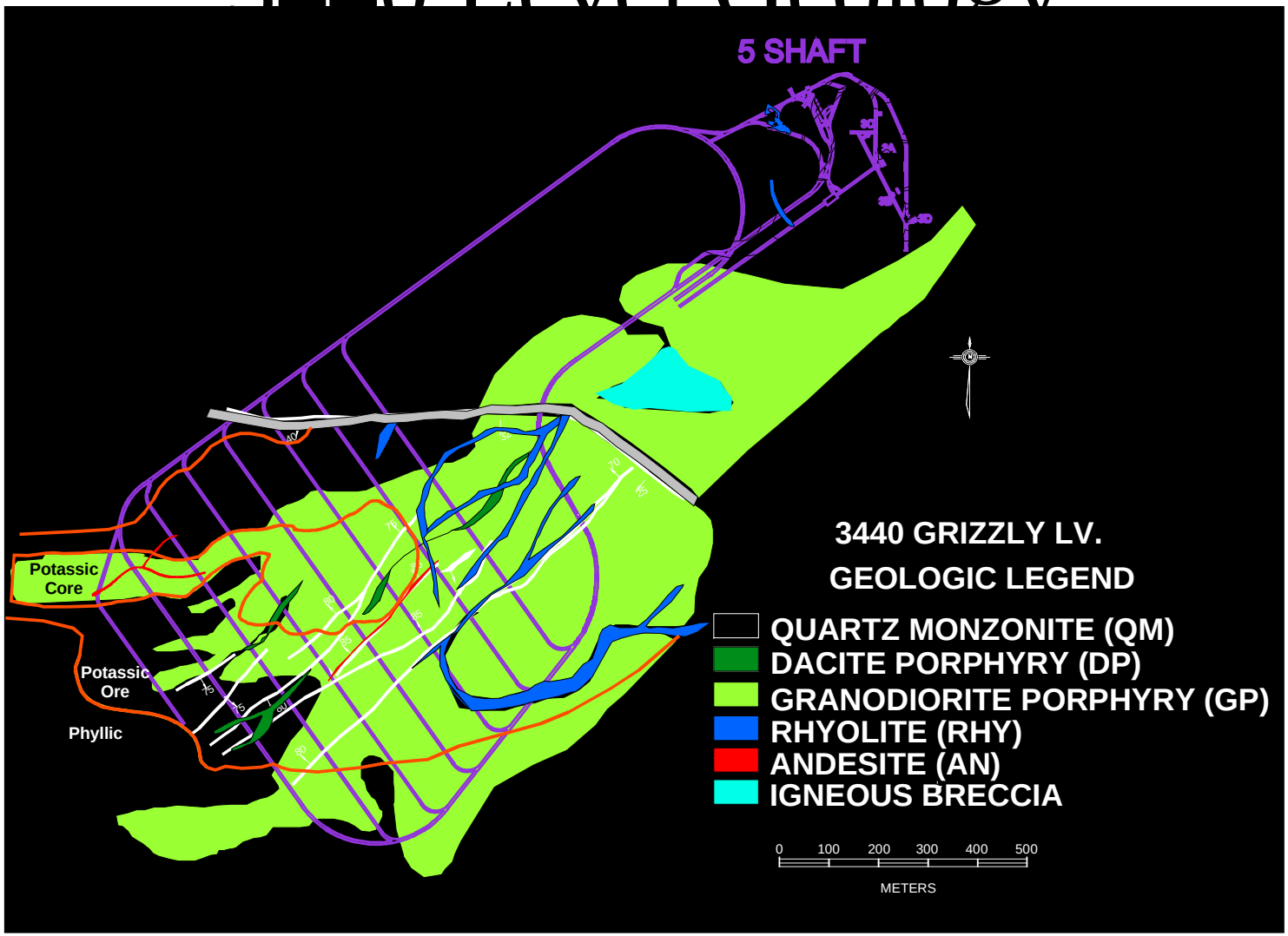

HANGOVER FAULT



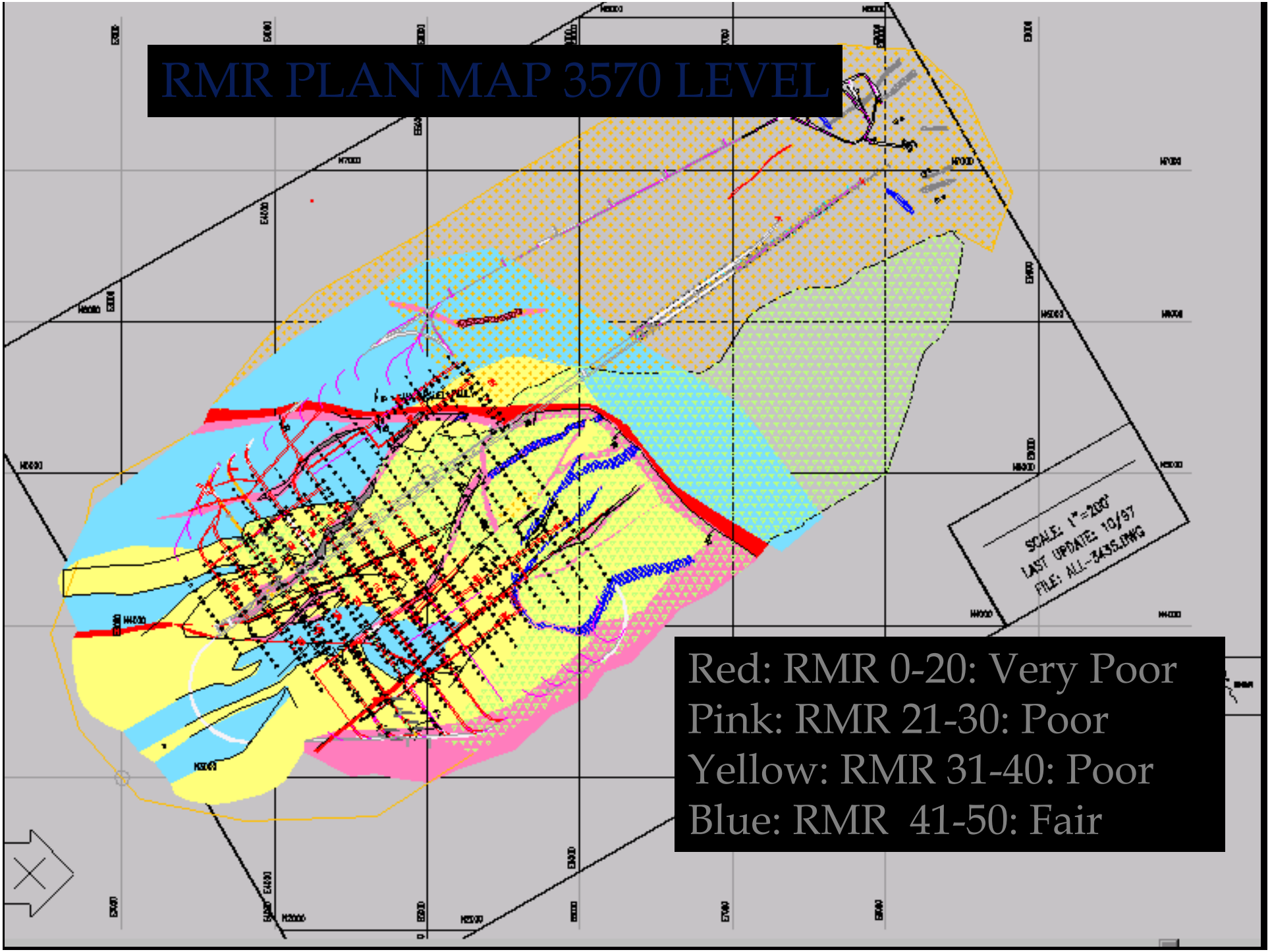

3A-3D Hoisting Shafts
SAN MANUEL FORMATION
RED ROCK FAULT
IGNEOUS ROCK
BLACK CANYON RANCH FAULT
CLOUDBURST FORMATION


BLACK
CANYON
RANCH
FAULT
70
EMBASSY FAULT
PEACHES FAULT
CROCODILE FAULT
BEAVER HEAD
FAULT
70°
60°
ABLE EARTH
FAULT
ROCK
FAULT
JENNIE
FAULT

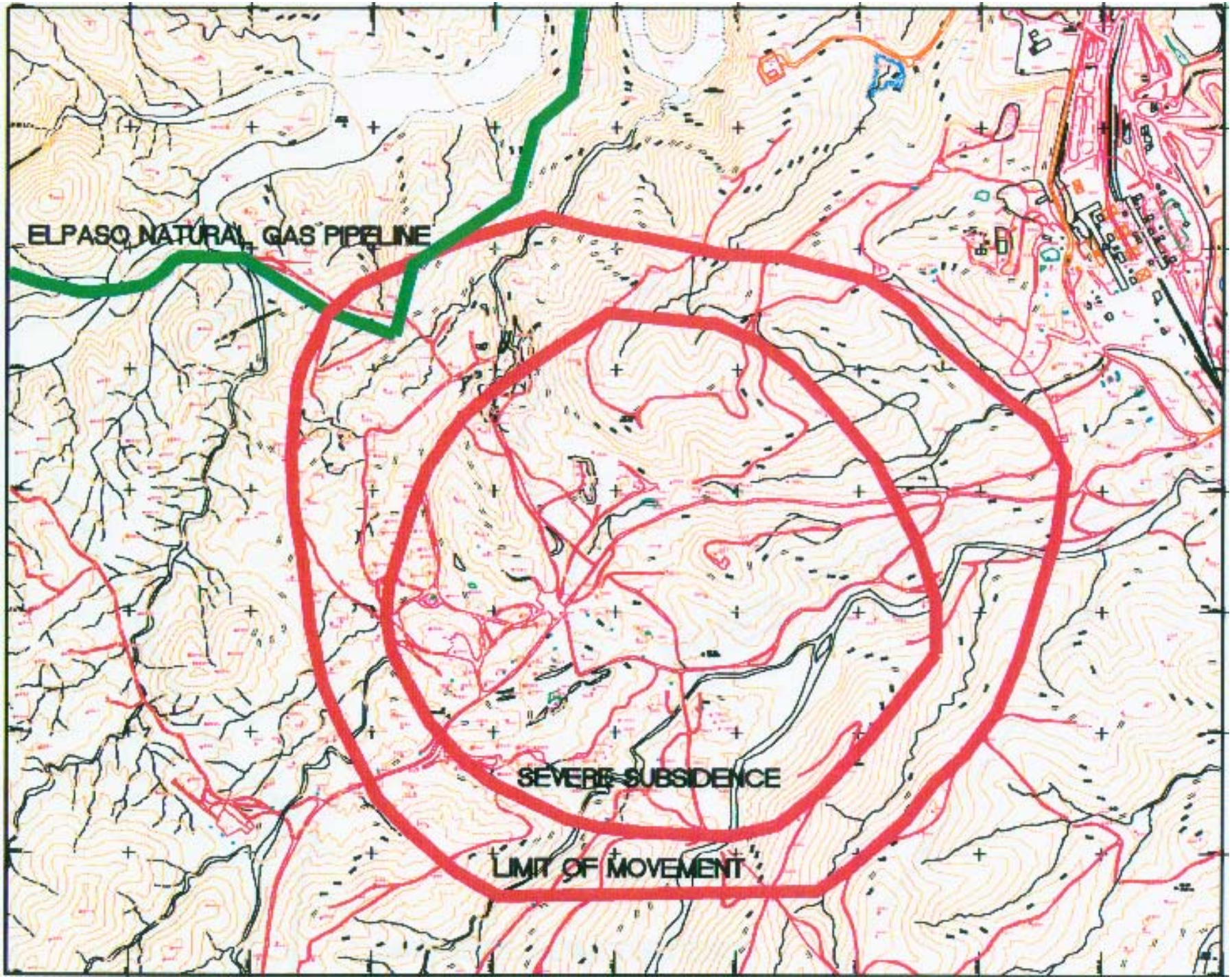
3440 Level Geology

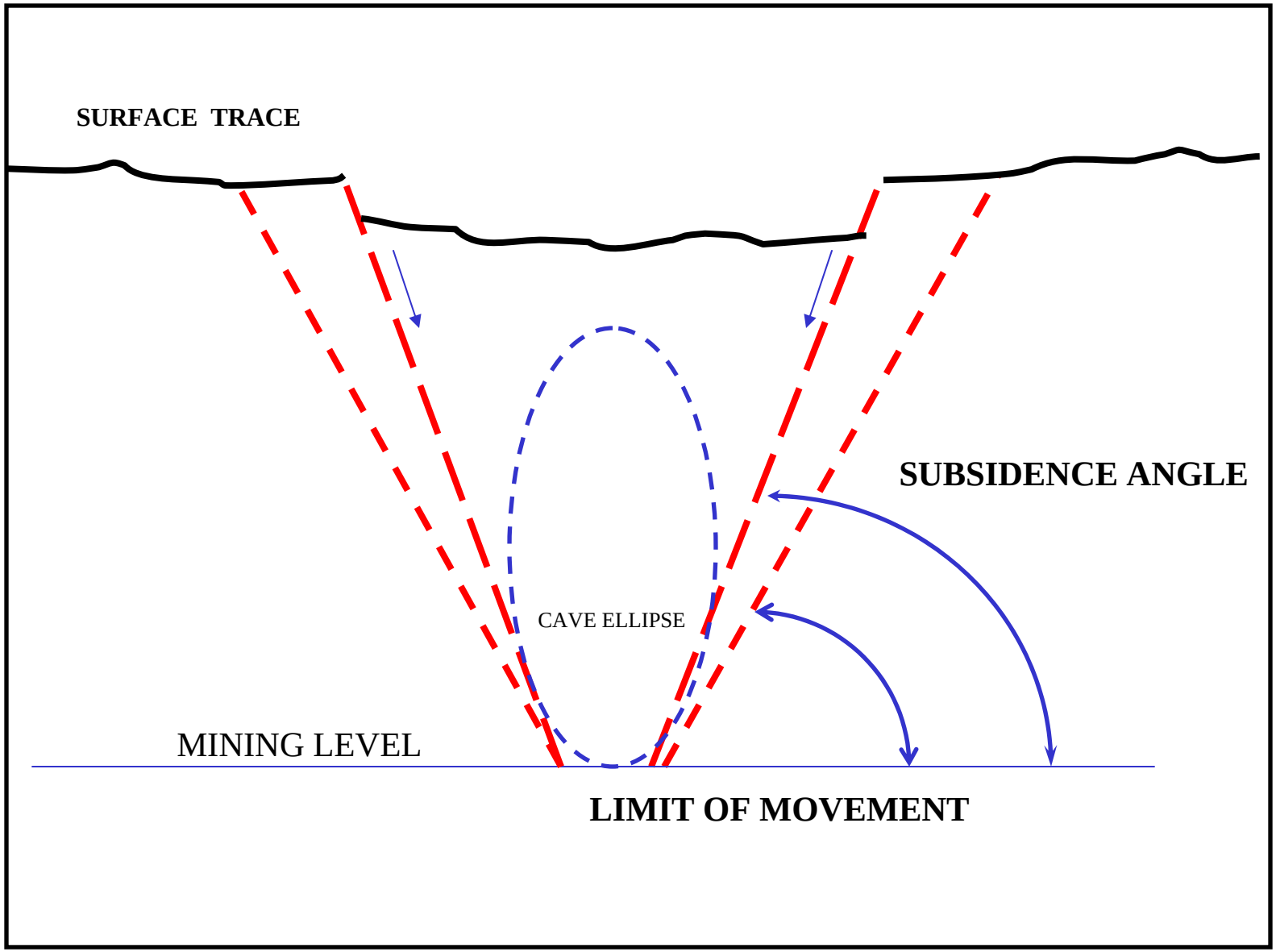


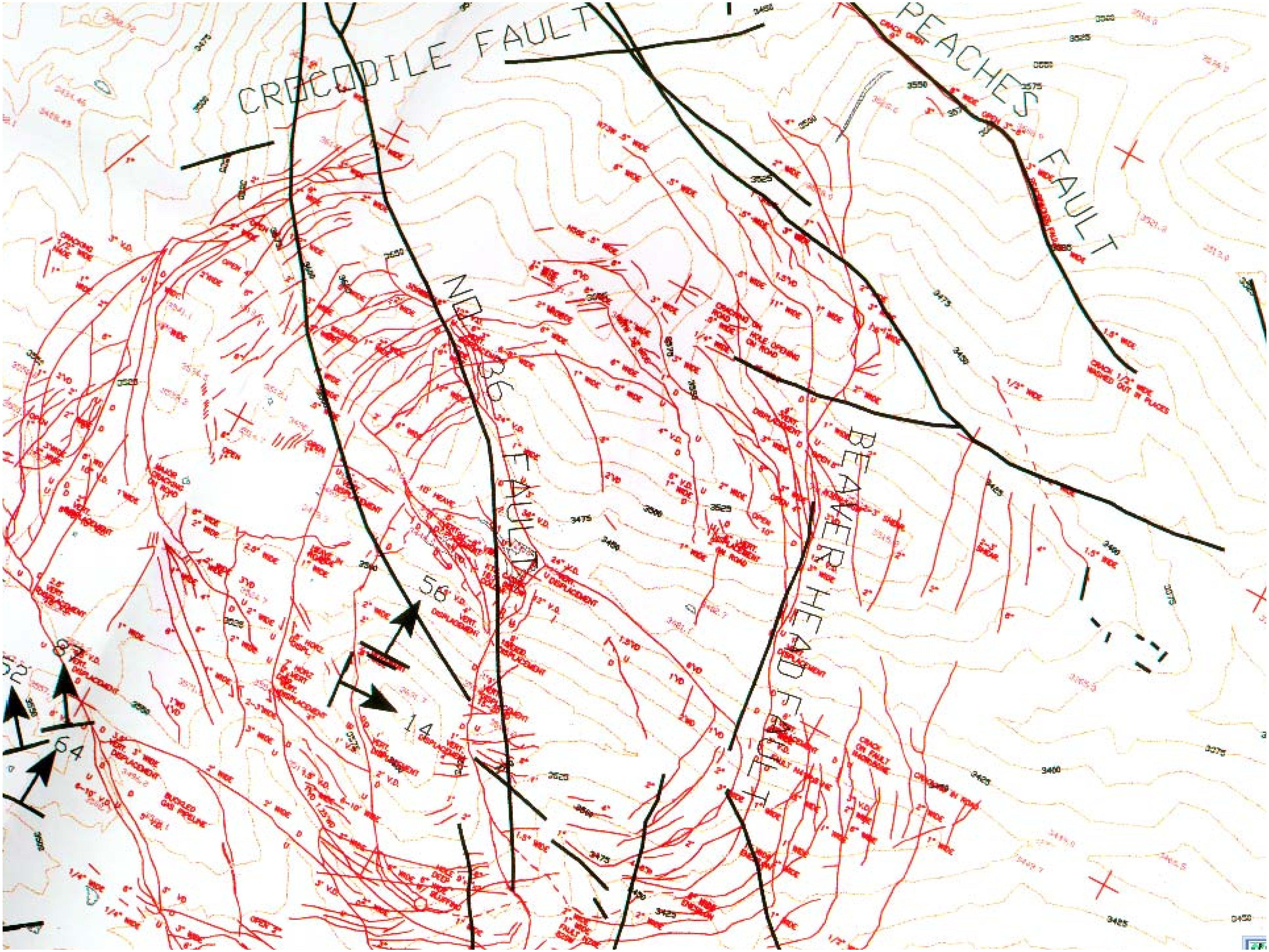
RMR PLAN MAP 3570 LEVEL



Red: RMR 0-20: Very Poor
Pink: RMR 21-30: Poor
Yellow: RMR 31-40: Poor
Blue: RMR 41-50: Fair


EL PASO NATURAL GAS PIPELINE
SEVERE SUBSIDENCE
LIMIT OF MOVEMENT


SURFACE TRACE
SUBSIDENCE ANGLE
CAVE ELLIPSE
MINING LEVEL
LIMIT OF MOVEMENT

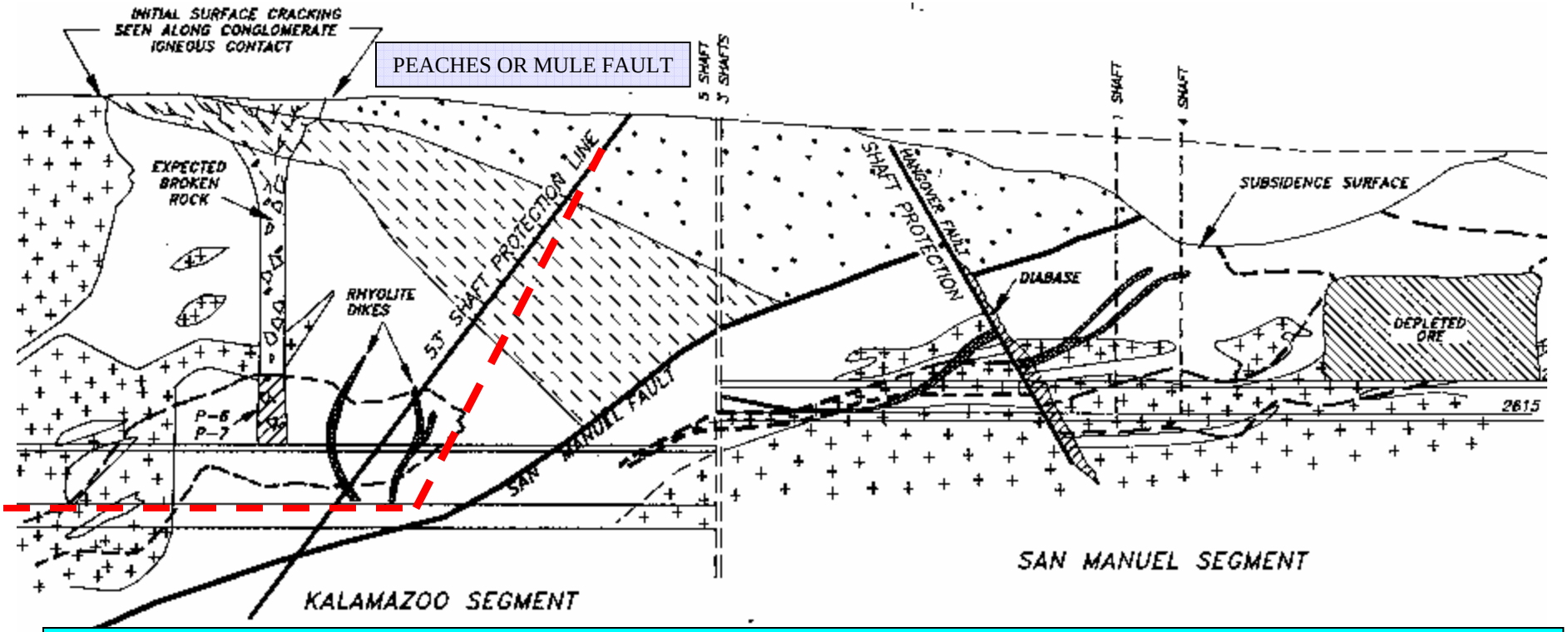

CROCODILE FAULT
PEACHES FAULT
NO. 36 FAULT
BEAVERHEAD FAULT
56
14
64


ABLE EARTH FAULT
MAJOR CRACKS
02
01
CONGLOMERATE-IGNEOUS CONTACT

Number 36 Fault, Near Station 20

Western Escarpment, On Dirt Road
Top 1993
Bottom 1995

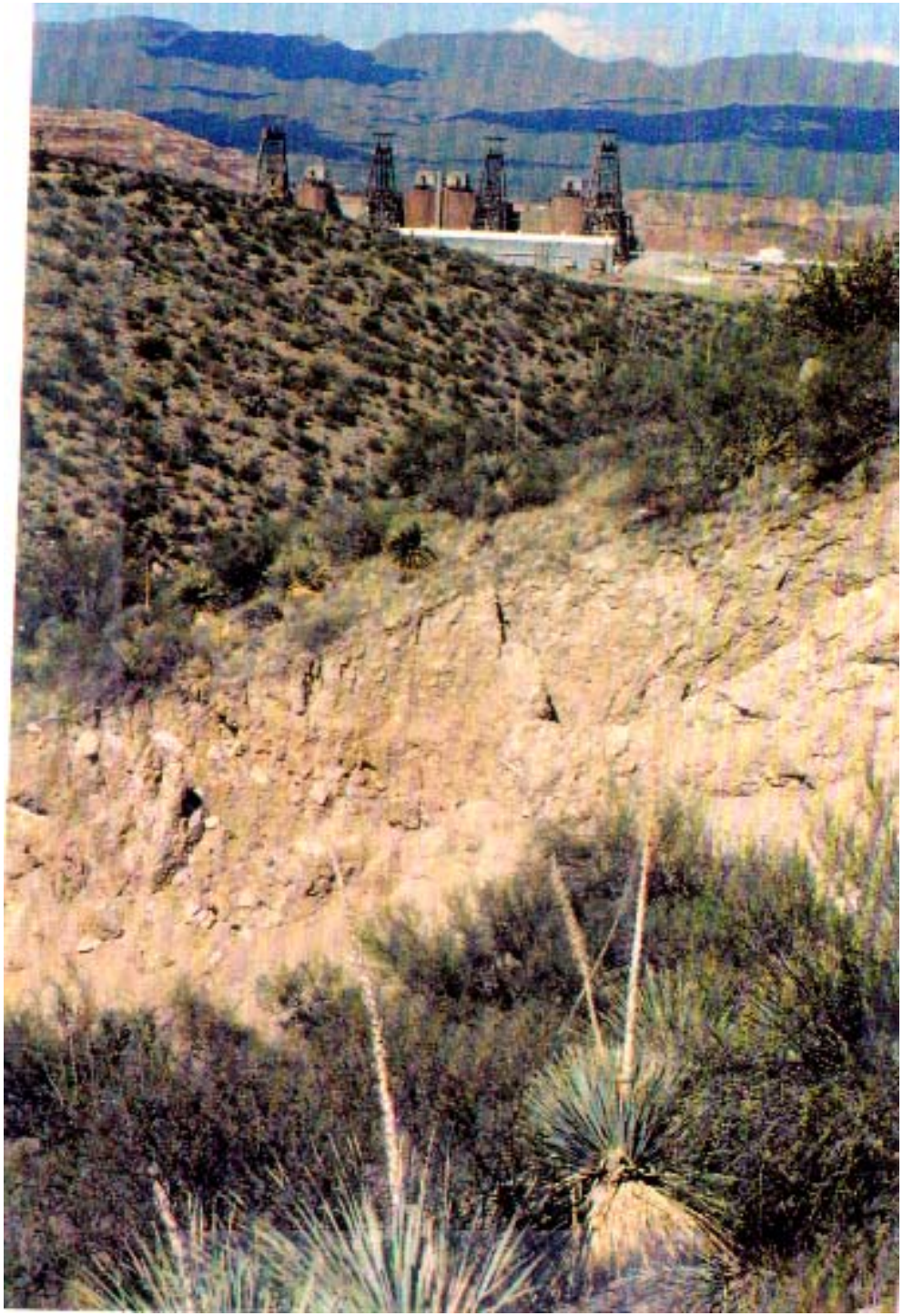
LONG SECTION SAN MANUEL-KALAMAZOO



63 DEGREE SHAFT PROTECTION ANGLE MAY INCREASE RESERVES 100 MILLION TONS (5-7 YEARS PRODUCTION)

E6000 E9000 E12000

GILA CONGLOMERATE
CLOUDBURST FM.
RHYOLITE
DIABASE
QUARTZ MONZONITE
ORE ZONE



Concerns

- Careful mapping of surface cracking through field checking
- Yearly aerial photos for contoured movement
- Periodic production shaft survey and inspections for damage or alignment
- Encroachment of damage to surface facilities
- Fencing off areas to limit access to cave areas